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Energy in the development strategy of Indian households—the missing half

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ABSTRACT

There is a growing consensus that universalization of modern energy services is central to reducing major elements of poverty and hunger, to increase literacy and education, and to improve health care, employment opportunities, and lives of women and children. In India, as per 2011 census, over 700 million people lack access to modern energy services for lighting, cooking, water pumping and other productive purposes. Devoid of these services people, mostly women, are forced to spend significant amounts of their time and effort on subsistence activities like firewood collection, carrying these head load for miles, and then burning these hard earned fuels inefficiently in traditional chullas. These adversely affect the health and standard of living for women and act as a barrier to gender development (here 'gender' means women unless otherwise specified). Although the links between gender inequity, poverty, and energy deprivation have been studied by many, not many practical solutions to the above problems have emerged. The present paper explores the nexus among gender–energy–poverty, highlights areas of gender concern, and suggests actions. We analyze how women from rural areas and low income households are at the receiving ends of energy poverty. We then analyze the roles women as an important stakeholders in universalizing modern energy services. We show how women self-help groups can be a vital link in large-scale diffusion of energy-efficient and renewable technologies. The paper concludes with policy pointers for sustainable development and gender empowerment through energy solutions.

Contents

1. Introduction

Energy drives all economies, both developed and developing ones. The need for energy is more pronounced in developing countries as they, because of low per capita energy use, tend to have low life expectancy, high infant mortality and low literacy [1,2]. It is not just about 'quantum' of energy alone; the 'quality' of energy service also affects the standard of living. The poor households not only has a very

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few energy needs, but also rely on lower quality fuels such as animal dung, agricultural waste and fuel wood. Reliance on these fuels limits the amount of service that can be obtained and affects gender adversely [3,4].[2] Developing countries not only show low level of development, but also high degree of inequality among men and women.

Use of modern energy services and gender empowerment are complementary to each other. Energy activities influence the status of women and in turn get influenced by them. Access to clean energy services improves women's social, economic and political status, reducing the time and effort involved in household chores including the drudgery of collecting wood, providing better health and educational conditions, expanding income-generating opportunities, and easing their participation in public affairs [6]. At the same time, greater sensitivity to gender issues increases the effectiveness of energy programmes and policies, as well as other types of development activities that involve energy use, by ensuring that the needs and concerns of both men and women are taken into account.

In the context of gender and energy, household energy has high importance. In India, households account for 40% of direct energy use (both commercial and non-commercial energy) and influence 70% of the total energy use (considering the energy required for goods and services consumed by households) [7]. However, the importance of energy consumption in household sector goes beyond statistics. The pattern of household energy consumption represents the stage of economic development of the family and the state of the women welfare. All household–related activities are women–centric. Energy-related activities in households are no exception. Typically women get involved in biomass collection, cooking, and other household chores. Hence, the energy situation in homes affects more than their male counterpart. Because of their socially determined roles, women are the first and foremost victims of energy services obtained from low-quality fuel and inefficient end-use technology. Greater access to modern energy services can provide significant social, economic and psychological benefits, especially for women and girls in developing countries, who are the primary providers and users of traditional fuels such as wood, dung and charcoal [8]. As the economy develops, energy consumption increases with increased use of energy appliances induced by changing lifestyles. Simultaneously, households shift to efficient technologies. Income, education, occupation and location play an important role in fuel/technology shifts. The shift towards modern energy services which are more user-friendly leads to improvement of the household in social ladder, particularly for the women of the family.

Gender issues have come to the forefront sectors like agriculture, forestry, and water. However, energy sector has been slow in acknowledging the links between gender, energy, and development. Policy-makers have largely ignored the role women play in traditional energy systems. There is a lack of gender concern in national-level energy policies. The 11th five-year plan (2007–2012) proposed to invest over $100 billion in energy sector, including coal, oil, hydropower and other renewables and nuclear–but less than 2% of this were proposed to go towards alleviating the drudgery suffered by women and children [9]. Hence, it is important to contextualize household energy consumption patterns with respect to gender concerns in order to formulate policies for promotion of sustainable gender empowerment through energy solutions.

This paper aims to study the issue by analyzing household energy consumption and the gender roles. The next section highlights the importance of women in the society in general, and in the context of energy in particular. The following section analyses the trends in household energy use in India and what it means to women. It looks into the availability and affordability of modern energy services among various sections of the society in urban and rural households. Next, the scheme to universalize basic energy services with specific emphasis on the roles of women is examined. The paper concludes with sustainable energy security strategy which would achieve gender empowerment as an important byproduct.

2. Gender matters

There is a positive relationship between gender empowerment and development. Societies which have emphasized female health care and where there is a higher participation of women in education and workforce have evidenced higher economic growth and development [10]. Developed countries have also shown reduced gender inequality and improved status of women which brings about greater macro-economic stability, whereas women's relative lack of opportunities in developing and least developed countries inhibits economic growth [11].

Gender inequality manifests as hierarchical genders relations, with men being superior to women, regarding them as inferior and less valuable solely by virtue of their sex. Gender hierarchy is manifested in family relationships, inheritance laws and customs; valuations of women's work and its general invisibility; and the power to make decisions in society, the family, work place, religious and other cultural institutions [12]. For generations, women have been denied access to resources of their own and thereby tend to be regarded as economic dependents. Societies have been characterized by marked preference for male children and discrimination against daughters from the early years of life. Gender inequalities in education, excess levels of female to male mortality and higher numbers of men to women in the overall population than is considered 'standard' is common in many societies [13]. This is apparent in the relative opportunities available to women and girls for development, education, health and nutrition. Such hierarchy is generally accepted by both genders, and it is not normally questioned within its cultural context.

Lagerlöf [14] believes that gender equality contributed significantly to the economic development of Europe over the past 2000 years. Gender differences in these countries can be traced back to cultural and religious roots.[3] It important that earnings and resource ownership is essential to make economic choices which allow women to move forward in time. That is why progressive thinkers advised external employment for women.

The importance of women as key drivers of development in environment and energy needs to get the attention it deserves [15]. Women suffer the daily drudgery of a 'un-mechanized' life, spending the bulk of each day performing basic manual tasks, including hauling fuel wood and heavy containers of water, often whilst caring for small children. Reduced drudgery for women and increased access to nonpolluting energy for lighting, cooking, and other household and productive purposes can have dramatic effect on women's education, literacy, nutrition, health, economic opportunities and involvement in community activities [8]. Gender-sensitive energy policies not only bring in equity and

[2] Gender can mean either man or woman. Gender is defined in social context and its manifestations and implications differ across societies and cultures [5]. However, in this paper, gender refers to female.

[3] The spread of Christianity might be the main reason for gender development in the western world. Unlike the Hindu society, the early Christians improved the status of widows allowing them to keep her husband's estate and extended women's rights to inherit and hold property. Christian women also got married at a late age unlike in Hindu society where child marriages and Sati Sahagamana (wherein a recently widowed woman immolates herself on her husband's funeral pyre) were common till 19th century.

Table 1
Household Energy consumption (PJ) (1950–2005).

Year	Population (millions)	Bio fuels	Kerosene	LPG	Electricity	Total	Per capita consumption (GJ)
1950	370	2884.5 (98.18)	50.4 (1.72)	0 (0.00)	2.7 (0.09)	2938	7.94
1960	446	3348 (96.26)	124.2 (3.57)	0 (0.00)	5.85 (0.17)	3478	7.8
1970	555	3906 (95.71)	157.5 (3.86)	2.7 (0.07)	14.85 (0.36)	4081	7.35
1980	687	4765.5 (93.61)	235.8 (4.63)	54 (1.06)	36 (0.71)	5091	7.41
1990	841	5242.5 (90.62)	301.5 (5.21)	117 (2.02)	123.75 (2.14)	5785	6.88
2000	1012	5130 (85.61)	282 (4.95)	288 (5.05)	292.5 (5.13)	5700	6.02
2005	1100	4950 (81.25)	265 (4.35)	427 (7.01)	450 (7.39)	5642	5.13

Note: Figures in parentheses represent percentages.
Source: CMIE [16].

Table 2
Energy carriers for cooking and lighting for different income groups (2004–05) in urban and rural India (values show percentage share of households).

End use	Energy carrier	Rural			Urban		
		Low income	Medium income	High income	Low income	Medium income	High income
Cooking	Biomass	91.28	85.94	57.55	52.21	13.02	1.66
	Kerosene	0.59	1.16	3.40	11.42	11.12	4.20
	LPG	0.73	7.65	33.10	26.46	67.77	82.00
	No cooking	1.56	0.66	3.20	2.40	4.63	10.59
	Electricity/others	5.84	4.59	2.75	7.51	3.46	1.55
Lighting	Kerosene	61.62	39.97	16.45	17.17	3.29	0.30
	Electricity	37.64	59.43	83.00	81.82	96.35	99.25
	Others (including no lighting)	0.73	0.60	0.55	1.00	0.36	0.45
Total households (Million)	58.58	71.89	14.46	25.19	31.56	6.31	

Source: Reddy *et al.* [17].

efficiency in daily life, but also alleviate poverty and ensure achievement of all millennium development goals (MDGs). For its successful implementation, the energy sector policy, like policies in other sectors, needs to be supported by programmes for gender equality and social relations and enacted through appropriate institutions at the micro- and macro- levels [9].

3. Household energy consumption—viewing through gender lens

3.1. Trends in household energy consumption—urbanization, income, fuel shifts and efficiency of utilization

Considerable changes occurred in the Indian household sector over several decades in the use of energy-consuming devices and in the behavior of energy users. Overall, the population has tripled during 1950–2005, whereas energy use among households has only doubled (Table 1). The increase in energy use can be attributed to natural increase due to population growth and increase in economic activities and development. At the same time, there has been a progressive movement towards modern energy carriers, which are more efficient.[4] Therefore, in spite of increased energy-related activities, per capita energy consumption has declined. Nevertheless, the share of traditional use of biofuels (such as fuelwood, dung, etc.) for cooking and heating is still far larger than the amount used for modern applications like refrigeration, and air conditioning.

Table 2 gives the household share for different fuels for cooking and lighting among urban and rural areas for different income groups.[5] While urban households have adequate fuel supplies and access to LPG and electricity, many rural areas still suffer from shortages. As per NSSO [18], 90% of rural households do not use clean cooking fuels and 45% of them do not have access to electricity. The corresponding figures for urban area are 33 and 7.8% respectively. This large urban-rural divide in household energy use can be attributed to non-uniform availability of resources or uneven access to infrastructure to avail the resources. However, energy availability is part of the story. Any energy carrier, to be used in a household, needs to be affordable. Energy forms a significant portion of the monthly expenses of the poor households and they do not use commercial fuels as they are unaffordable. High-income households have a greater choice in selecting an energy carrier and many opt for cleaner, comfortable and more efficient modern energy carriers such as electricity or LPG [19]. So, as evident from Table 2, as one moves down from urban rich to rural poor there is an increased dependency on energy carriers, which are traditional, inefficient, and cause misery to women.

3.2. Women's invisible time and effort

The traditional form of energy (bio-fuels), which dominate the energy spectrum, is different from its counterparts such as kerosene, LPG, or electricity in one respect. Unlike others, the households prepare (cutting/gathering, transportation, breaking into small pieces, etc.) the bio fuel themselves. Being the primary cook in the

[4] The efficiency of utilization of energy devices for biofuel, kerosene, LPG, and electricity are typically, 10, 40, 70, and 75% respectively [17].

[5] Income groups are arrived at calculated on the basis of Monthly Per Capita Expenditure (MPCE) as given by NSSO [18]. It is assumed that MPCE less than Rs. 410, in the range Rs 410–Rs 890 and over Rs 890 are considered as lower-, middle- and high- income categories in rural areas and less than Rs 675, in the range of Rs 675–1880, and over Rs 1880 in urban areas. All values in are in Indian rupees. per household.

household, by default women shoulder the responsibility for fuel collection and preparation and fetch water as a part of cooking-related activities (Table 3). Girl child of the family shares the burden in these tasks. A typical day of a rural household will be witnessed with women and children walking distances at forenoon or afternoon to collect wood and other bio fuels and process them for firing in their traditional stoves.

Even in the 21st century, bio-fuels prevail in rural households and thus the drudgery for women. Moreover, the unpaid labor provided by the women and the time spent by women on these survival tasks does not enter the market system and goes unaccounted and unnoticed. For example, while the energy used by an electric pump for water pumping can be easily measured and reported, the energy expended by a woman in fetching water goes unmeasured, unmonetized, and unrecorded in energy statistics. Trucks that transport fuels are a part of market mechanisms whereas the energy of women head-loading the same is excluded [21]. ESMAP energy survey of Indian rural households in 1996 [20] has accounted the time spent by different households in cooking and fuel collection activities. Occupational background influences the time spent in the collection of fuel for cooking. Labor households, who are the poorest among the lot, spend the maximum time in collection irrespective of the type of fuel used for cooking. The lives of the relatively rich households are little better than those of poor households. Families practicing professions spend 10–20% of the core cooking time in fuel collection, whereas about 20–40% of the time in collection. These responsibilities often constrain their capacity to undertake other employment activities.

As IRADe [9] observes, together women and children collect about 28% of all the primary energy. However, no inputs in terms of investment, management or technology are provided to them by the government—something that all other energy sectors take for granted. The most important motivation factor behind the use of bio-fuels (wood, cow dung and crop residue) is that its direct cost is almost zero. The opportunity cost, in terms of the time spent by women, is not taken into account by households which consider them to be free and only destined for such activities. Had the traditional fuels born tangible costs, and had the male community had to involve in the procurement of such fuels, the households would have approached differently to these traditional fuels, and showed more willingness to opt for higher versions.

3.3. Impact on health and education of women

The use of traditional biomass fuels does not limit the drudgery of women to the back bending job of collection and transportation of the fuel, but also its use. The typical efficiency of biomass stove is 10% which indicate how inefficiently the hard-earned energy is used. Due to inefficient use, these fuels, when burnt, give off significant quantities of smoke and particulates which have adverse effect on health of women and girl children. The indoor air pollution level, i.e., mean 24 h RSPM concentration is shown in Fig. 1. The exposure levels for the wood and mixed fuel users range from about 400 to 700 micrograms per cubic meter of air. As a comparison, the Environmental Protection Agency of the United States recommends average exposures to be no greater than 50 micrograms per cubic meter of air [23].

Another aspect of this health impact is that it is 'invisible'. Since the indoor air pollution acts as a slow poison in the kitchen and affects the health of women, who are at the bottom of the family health priority, these impacts are considered unavoidable yet unnoticeable. Inefficient fuels coupled with inefficient stoves have prolonged cooking, which in turn makes longer exposure to harmful smoke detrimentally impacting women's health. Children also get exposed to these pollutants more often as they often play in the proximity of their mothers. In this regard, improved stoves have multiple advantages. It not only reduces the cooking time, but also uses less fuel; so in turn saves money and reduces the drudgery of colleting fuel. Also improved stove in quite a few cases have a chimney, which reduces the exposure to cooking smoke.

According to an IGIDR study [24] the health impacts of the use of bio-fuels are quite high for adult women. The losses incurred because of cooking fuels, including work days wasted, expenditure on illness and lost working days due to illness are Rs. 29 billion per year in the rural areas of Rajasthan. Smith [25] has indicated that high risks such as respiratory infections (ARI), chronic obstructive pulmonary disease (COPD), lung cancer and also tuberculosis (TB), asthma, and blindness are prevalent in India on account of indoor air pollution. Conservative estimates attribute 400–550 thousand premature deaths annually to the use of biomass fuels in these population groups. Using a disability-adjusted lost life-year approach, the total is 4–6% of the Indian national burden of disease, placing indoor air pollution as a major risk factor in the country [25]. As per World Health Organization (WHO), indoor air pollution which is referred to as 'killer in the

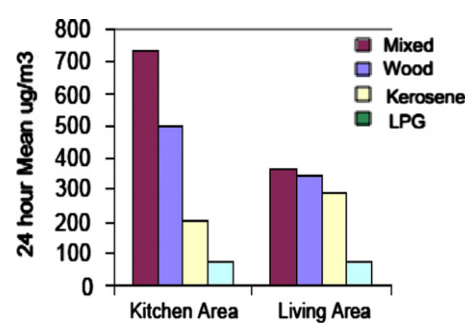


Fig. 1. Indoor Air Pollution caused by different fuels.
Source: World Bank [22].

Table 3
Fuel use and time allocated by women in its collection, preparation and use.

Type of Family	Fuel wood				Dung				Crop residue			
	% using fuel	Collection fuel (h.)	Cook (h.)	Collection as % cook (h.)	% using fuel	Collection fuel (h.)	Cook (h.)	Collection as % cook (h.)	% using fuel	Collection fuel (h.)	Cook (h.)	Collection as % cook (h.)
Professional*	61	0.5	2.79	18	53	0.4	2.98	13	24	0.41	3.15	13
Large Farmers	81	0.67	2.53	26	66	0.7	2.52	28	31	0.53	2.57	21
Small Farmers	78	0.92	2.58	36	55	0.78	2.85	27	26	0.44	3.12	14
Artisans and Laborers	60	1.08	2.56	42	58	0.77	2.91	26	45	0.65	3.07	21

Source–ESMAP Energy Survey 1996 [20].

* Families in business offering services

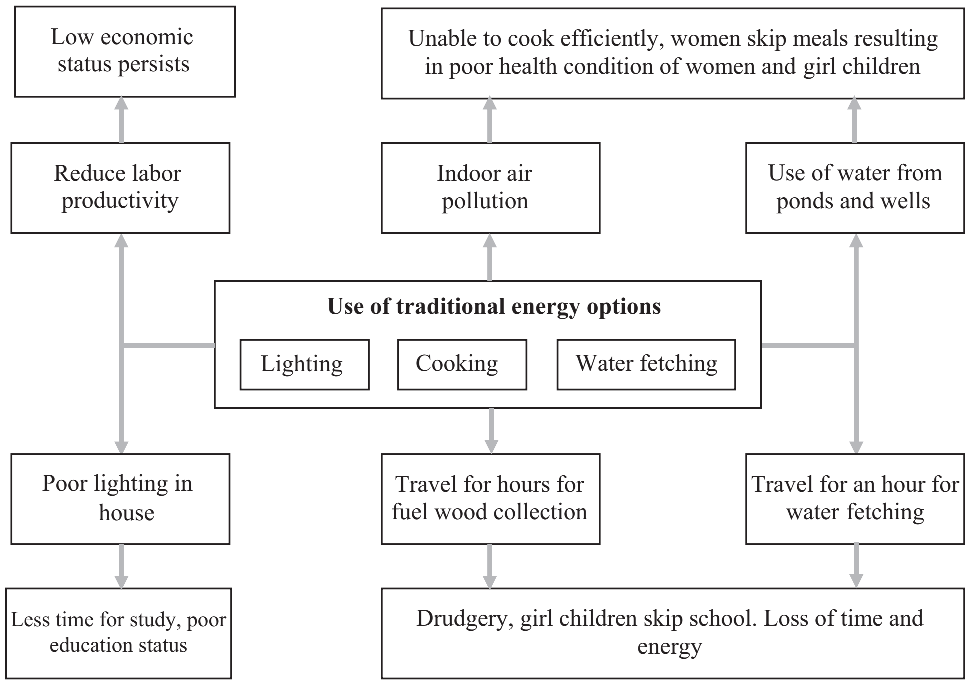


Fig. 2. Cause and effect relationship of traditional energy use.

kitchen' is responsible for 1.6 million deaths per year, i.e., one life is lost very 20 s [15].

In addressing energy poverty it is crucial to understand and deal with the gender dimension. UNDP [8] reports reveal that when women are overburdened, they are more likely to keep their daughters at home and away from school to assist with household activities, including fuel and water collection, thereby limiting opportunities for girls to move forward through education, thus increasing the likelihood that their families will remain in poverty. Education and literacy levels are positively correlated with decreases in fertility rates. Women, with more education, tend to have fewer children, and to be better able to care for them. The fuel-related burdens experienced by women in developing countries hinder social and economic progress throughout the community and have long-lasting impacts when personal and social development opportunities are lost.

4. Climbing the development ladder

One of the major components of energy choice of a household relates to the status of technology it uses. Irrespective of the quantum of energy flowing through various stages of the energy cycle, technology is an important driver of efficiencies, costs and prices, as well as the pattern of consumption of energy in an economic system. Since technological changes have a significant impact on the energy use, any future plans for the energy sector and its role in an economic system must take into account the technological progress. At the consumption end of the cycle, we have to understand that the demand for energy is basically a derived demand, which depends on factors such as prices of energy and the cost of energy using device, availability of the energy technologies, incomes of consumers, and energy perceptions in the households.

In this context the status of the women in the family matters. In the households and communities where women labor is discounted and home making is considered as a soft, free, and leisurely work, there the energy decisions are not consistent with the comforts of women. This is one such example of dichotomy where activities are women-centric, but decisions remain with men.[6] Slight improvement in energy technology can have significant improvement in the standard of lives for women. For instance, let us consider the case of lighting.

Table 4
Modern energy option to climb the development ladder.

Energy service needed	Current energy option	Modern energy option
Cooking	Bio-fuels (wood, dung, agriculture waste, etc.)	Gaseous fuels (bio gas, LPG, PNG etc.)
Lighting	Kerosene	Electricity (Grid and off-grid)
Water pumping	Manual	Electricity (Grid and off-grid)

Good lighting acts a facilitator in household activities. Availability of lighting increases the productive hours in the household. Very poor quality lighting or no lighting makes the women, who are the main managers of household activities to depend heavily on daylight hours. Also the poor quality of lighting, do not provide women who confine themselves to the four walls of house to read or do any close work. As per UNDP [8], Global evidence has shown that the availability of illumination in the home increases female educational attainment and literacy and extends the working day of women to include income-generating opportunities such as in cottage industry. Lighting in public places also increases the safety of women and communities and allows women greater access to public gatherings.

From the perspective of the households, the shift from low to high efficiency fuels/technologies increases the standards of comfort, cleanliness, and convenience. The increased possession of modern carriers becomes a symbol of status and success. In the consumer society, the consumer's self-respect depends strongly on his/her level of possession of these goods and the fuel/technology shift from the lower to higher order satisfies his/ her ego.

[6] Another such example is decision related to frequency of child birth.

Table 5
Improving the position of women through modern energy services.

Modern energy services	Direct benefit	Indirect benefit	Strategic benefit
Gas for cooking	(i) Less time and effort in gathering and carrying firewood (ii) Reduced indoor air pollution and improved health through smokeless services	More time for productive activities	Lesser deforestation
Electricity for lighting	Increase in working/studying hours, and improved conditions during evening hours	Increased possibility of activities during evenings and nights	Streets become safer by encouraging participation in other activities (e.g., evening classes and women's group meetings).
Electricity for water pumping	Pumped water provides better hygiene and water quality.	Reduced need for haul and carry	Better health standards, check on water-borne diseases
Mills for grinding and other mechanical works	Reduces the burden of grinding rice at home	Increases variety of enterprises and increased incomes	Greater access to commercial and socio-political opportunities

However, there is little agreement on specific goals and the strategies to attain these benefits when we consider gender issues. Technology can be savior to women time and drudgery, to which the male counterparts put a blind eye. It is not only about providing cooking fuel that is demanding in terms of women's energy and time, there are a whole range of tasks on which the household is dependent for its survival, such as water provision and food processing.

Traditional fuel use has cumulative impacts cause and effects which keep women voiceless, uneducated, weak, and disempowered (Fig. 2). Much of this drudgery could easily be reduced by the application of modern energy forms and efficient utilization of biofuels such as biogas (Table 4).

Modern energy services have a great potential to contribute to gender equity so that women and men benefit fairly from access to these services (Table 5). Access to modern energy services result in positive impacts such as: freeing the woman's time from domestic tasks, enabling access to educational media and communications in schools and at home, mitigating the impacts of indoor air pollution on women, allowing access to better medical facilities for maternal care including refrigeration and sterilization, and enhancing income generation activities [26]. Energy carriers can also be considered as material assets. Therefore having access to sufficient amounts of good quality energy will make the household to climb the 'Comfort ladder' and thereby the 'Development ladder'.

5. Universalization of modern energy services—impact on gender

Since household energy activity is women-centric, energy universalization program benefits women most. Women reap the best benefits of climbing the energy ladder. Moreover, on most occasions, as users, women are aware of the fuelwood species, the smoke that emanates, and the cost of indigenous alternatives. So energy universalization programs are not only aimed 'for' women welfare, but also need to be spearheaded 'by' women. However, unfortunately under India's family system, women are hardly consulted in choosing a fuel or technology.

In the energy universalization program model, we revisit the EMPOWERS (Entrepreneurship-based Model for Provision Of Wholesome Energy-related basic Services) model proposed by Reddy et al. [17]. The three actors in this model, viz., the entrepreneurs, NGOs, and consumers can be inducted into the self-help group (SHG) structure. Before going into the model, let us learn about SHG.

Self-Help Group (SHG) is a small voluntary association of poor people, typically constituting 10–20 women, preferably from the same socio-economic background, who come together for the purpose of solving their common problems through self and mutual help [27]. They are typically a three-level structure (Fig. 3). The lowest level is the individual SHGs. Typically, about 15–50 SHGs make up to form a 'SHG Cluster' with either one or two representatives from each SHG. Depending on the civic and geography situation, several clusters are made up to form a SHG federation [28].[7]

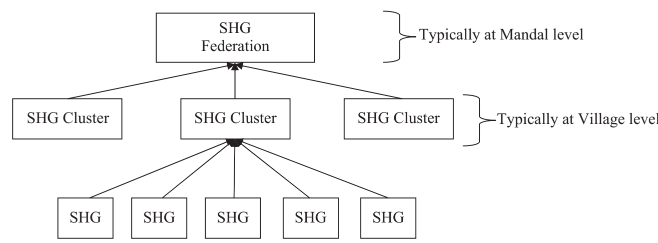


Fig. 3. SHG Structure.
Source: Reddy and Manak [28].

The SHG promotes small savings among its members, which are kept with a bank, which in turn provides loan which is lent to SHG member(s). In short, SHG operates as savings-first business model whereby the member's savings are used to fund loans [28]. SHGs have a phenomenal growth in India, growing at an average annual growth rate of 82% during 1993–2006, and the credit amount grew at a rate of 110% [29]. The major program is the SHG-bank linkage program which was initiated by the National Bank for Agriculture and Rural Development (NABARD) in 1992. By the financial year 2005–06, the program covered over 6,20,000 SHGs, involving over nine million households of whom over 90% were women members and 95% on-time repayment of loans [29,30]. SHGs have clearly succeeded in India in terms of developing women community life, providing them with some degree of financial independence, and empowering women in family decision-making.

In the proposed EMPOWERS model, participation of three actors, consumers, entrepreneurs, and NGOs can be channelized through the SHG structure (Fig. 4). The mapping is given as follows:

SHG: Individual SHG groups can act as consumers thereby avoiding multiple individual contacts. Since energy services are women-centric, it is expected that SHGs will approve such

[7] The dependence on geography can be exemplified as a fishing community spread across several coastal villages can form one federation. Similarly a tribal community in different contiguous hamlets of mountainous locality can form a federation. From civil structure perspective, villages under a particular mandal can form a federation.

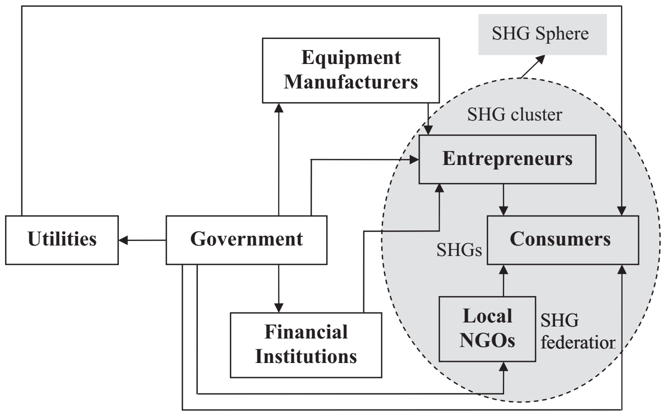


Fig. 4. Empower model with SHG Sphere.
Source: Adapted from Reddy *et al.* [17].

services. Provision of services in a group facilitates delivery of services and collection of bills. Also, as an SHG, consumers will safeguard common public property like biogas connection networks.

SHG cluster: SHG clusters are typically at village-level and constitute several SHGs. With linkage to the banks already in place, SHG cluster can act as an entrepreneur and initiate energy projects among the community through soft loans from financial institutions. SHG cluster will form the central role in EMPOWERS model. From the government and policy-makers point of view, SHG clusters would be the diffusion targets and not millions of "end-users". These clusters can market energy-efficient devices. Through this entrepreneurial scheme, SHG cluster can strengthen its financial base. These are expected to be successful because of good understanding of consumer needs and environment.

SHG federation: SHG federations can assume the role of an NGO, get itself trained in providing modern energy services, spread awareness on multitudes of benefits of such services, and build capacity. Energy solutions triggered through SHG federations will succeed as they constitute the homemakers, who are the victim of energy-drudgeries. Moreover, they can appreciate the benefit most being the benefactors. Since the victim and benefactors and the decision-making body is one and the same under a SHG structure, the decisions would promote modern energy services. Financial institutions and civic bodies, with already established rapport with the SHG federations can facilitate such projects.

One must note that in household energy management, women experience constraints and stimuli; have abilities and weaknesses; and hold rights, responsibilities and obligations. Hence they can optimize on households benefits and costs once they are allowed to participate in decision making. Hence, government can aim to induct more women in decision bodies of financial institutions, utilities and in other government institutions dealing with energy solutions. In the case of energy management, the buck needs to stop at women, who can instrument energy universalization a reality.

6. Gender, energy and sustainability

The present approach envisages the provision of modern energy services through biomass, wind, solar, and small-scale hydro. This offers major opportunities for income generation and livelihoods diversification, as well as fuel provision and environmental protection. It also ensures sustainability of resource supply (for example, biomass supply sustainable forest management by communities). Because of their direct involvement in obtaining energy services for the family women are naturally mindful of natural resource management and the environment thus decreasing the ecological foot print.

Rural households, in general, use electricity primarily for lighting and entertainment (television). They do not see the opportunities for making productive use of electricity apart from agriculture water pumping. Hence, there is a need for diversifying rural economic livelihoods through modern energy services. There is a lack of 'manpower' for local energy suppliers (e.g., solar-powered battery charging, micro-hydro installations with mini-grids) and the need for entrepreneurs who can supply, install and repair the energy hardware. This lack of 'manpower' can be compensated with 'women power' if SHGs steps in. Given the success of SHGs, and their established rapport with different actors, the EMPOWERS model with SHG federation, SHG cluster, and individual SHG groups undertaking the roles of capacity builders, entrepreneurs, and consumers respectively. SHG-driven EMPOWERS model is more likely to be successful, replicable, and sustainable.

Availability of mechanical and process heat technologies can be a stimulus to the start up of various small-scale industry enterprises (sawing, food processing etc) as well as service enterprises such as hairdressing, photocopying and internet café. Operating a grain mill can also be a women's domain, since it improves product quality while reducing women's drudgery. In general, women-headed enterprises are located in the home, and these 'cottage industries' have low rates of return which prevent inward investment, hindering innovation and expansion which are regarded as key factors in enterprise sustainability [31]. Access to resources (such as credit, land and education, which are recognized as key factors in micro-enterprise development) will make such industries sustainable. Once the resources are available, women will begin to take decisions on their own, at the home front, such as observing family planning practices, objecting to son-preferences, and providing education to the girl child. Educated women are likely to take outside employment rather than stay at home with children. Education enables them to have late marriages which can result in fewer children. This also increases self image of women (e.g. self-esteem, capacities in development activities, knowledge and skills). Thus, women's access to decision-making within the household and community will not only increase their ability to influence energy resource allocation, but also could make a significant contribution to the development of sustainable livelihoods and gender-equitable society.

7. Conclusions—the way ahead

The nexus between poverty, energy, health, education and gender empowerment have been discussed in this paper. The situation with women is like having "responsibility without authority". It is the responsibility of women to collect the fuel, carry, process, and use it; without having a say in the choice of fuel, the usage method, and the technology adoption. These arduous tasks not only reduce the time available to contribute to other aspects of livelihood strategies, but also affect women's health. Along with collection and transportation, cooking in unventilated kitchen has its own specific impacts. Low- and middle-income groups in rural areas and low-income groups from urban regions are the main users of the bio-fuels (largely fuel wood). Most of these fuels are collected by women and children who carry loads of fuel wood, sometimes covering as far as five kilometers. Their lower status in a largely patriarchal society renders them ideal candidates for this back-breaking, time-consuming, and in many cases unhealthy but essential 'survival work'. This 'hard earned' energy is used very inefficiently, converting only about 10 per cent of the total into useful energy. The linkage between poverty, living conditions,

livelihoods, and the way energy is used is clear from various observations made in this paper.

In developing countries like India, the potential for demand reduction is often even larger. Energy needs in India are different from those of the West because of differences in the requirement of energy services, e.g., space heating is important in the West, whereas meeting of basic human needs such as cooking and lighting are of paramount importance in India. The poor often do not have access to efficient fuel/technology and depend on their own labor, on animal power or fuel wood, and other types of biomass, which have a high price in terms of human time and labor. They also have health and gender impacts, which are usually more severe on women. Hence "climbing of development ladder" (wood stove→ efficient wood stove→LPG stove and/or electric hot plate→increased leisure time→increased income). It means *addressing energy development, poverty, social justice, equity and gender issues as parts of the same political process of development*. It involves bridging the gap between changing attitudes and environmental degradation and the patterns in the use and reuse of the earth's resources. This should be the strategy that could have positive impact not only on the quality of life but also on the resources and the environment.

The Indian household energy problem is not primarily a problem of the scarcity of energy per se, but inefficient energy conversion to obtain desired services. The consequence of such utilization is the serious health hazard of inhaling smoke from fuels used for cooking. This inefficiency of utilization is a factor behind indifferent health, poor education atmosphere, and hardship imposed on women and children, etc. The gathering of fuel wood becomes more difficult as land degradation spreads. The supply of fuel wood, especially to urban areas, is a contributing factor to deforestation and land degradation. Given the magnitude of these problems and issues, the proposed solutions need to be sustainable.

To achieve this goal, we need to design new approaches by engendering the energy approach. The country wide SHG networks can be tapped for this purpose. In this paper, we have proposed to integrate the SHG structure to energy solution model. SHGs at the lowest level can be energy consumers, thereby being the diffusion targets instead of being millions of end users. At cluster level, SHGs can own the energy enterprise built with their own funds and supplying energy services to all the members. SHG federation can provide the necessary capacity building and establish the necessary linkages with other stakeholders like financial institutions, equipment manufacturers, utilities, and government agencies. Likewise, energy model driven by SHGs is likely to succeed because in this scheme of things, the decision-makers, viz. women are the victims and benefactors.

Through the implementation of such schemes, economic efficiency and rural growth can be achieved by supplying sufficient energy at least cost to the poor. Reduced drudgery for women and increased access to nonpolluting power for lighting, cooking, and other household and productive purposes can have significant impact on women's levels of education, literacy, nutrition, health, economic opportunities and involvement in community activities. These improvements in women's lives can, in turn, have significant beneficial consequences for their families and communities.

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